

Remarks

Claim Rejections - 35 USC § 103

Claims 1, 2, 4, 11-14 and 18 were rejected under 35 U.S.C. 103(a) as being unpatentable over Toida (WO 2003/097771), noting that the WIPO document is cited from the English translation, US 2005/0173297.

Claims 3, 9, and 19 were rejected under 35 U.S.C. 103(a) as being unpatentable over Toida (WO 2003/097771) in view of Imura et al. (EP 1 142 636).

In the *Response to Arguments* section of the Official Action, it was stated that Applicant argued that claim 1 limits the zeolite to the proton-type zeolite which has a content of cations other than protons of 5 mass % or less and that this is not taught or suggested by the prior art. Applicant submitted that Toida discloses that nonproton-type zeolite is preferable.

The Official Action stated that this argument was not found persuasive because the claim does not necessarily require a given proton content, noting that instead, the claimed "content of cations other than protons of 5 mass % or less" merely limits the content of cations other than protons on the catalyst.

Accordingly, the Official Action stated that the claim could encompass a catalyst comprising less than 5 mass % of cations other than protons and some amount of protons (H+).

The Official Action stated that, as to the submitted re-written results of the Examples and Comparative Examples and the arguments, Applicant argued that it is clear that the zeolite of claim 1 shows good performance in adsorptive desulfurization.

The Official Action stated that this argument was not found persuasive because the data relied upon in the table to demonstrate unexpected or improved results over the comparative examples are not commensurate in scope with the entire claimed ranges. Specifically, the SiO₂/Al₂O₃ molar ratio ranges from 5.5 to 27.4 and the cation mass content ranges from 0.02 to 3 mass %, both of which do not encompass the entirety of the ranges claimed in instant claim 1.

The Official Action stated that Applicant argued that the present invention is an adsorption desulfurization which does not accompany hydration and thus, the mechanism of desulfurization in the invention is totally different from Imura.

The Official Action stated that this argument is not found persuasive because while Examiner agrees that the claimed process is directed to adsorptive desulfurization, the claim is not limited to only adsorptive desulfurization and thus does not exclude the possibility of a hydration step.

Applicant appreciates this response and the Examiner's comments.

Amendments

Claim 1 has been amended to remove the recitation to "zeolite" and to add the subject matter from claims 2 and 13.

Claim 2 is amended to recite zeolite to be used together with a solid superacid catalyst. No new matter is entered by these amendments.

Thus, the claims are limited to the hydrocarbon oils of "kerosene or gas oil", previously in claim 13. Claim 13 is now cancelled. Since the previous subject matter of claim 13 and 2 now appears in claim 1, Applicant believes the claims are clearly non-obvious. Entry of this amendment is solicited, and allowance of the claims is solicited.

Traverse

The rejections are traversed.

Although "kerosene or gas oil" is now recited in claim 1, the deletion of "zeolite" in claim 1 is significant.

Toida does not disclose a kerosene or gas oil being brought into contact with a solid superacid catalyst selected from sulfated zirconia, sulfated alumina, sulfated tin oxide, sulfated iron oxide, tungstated zirconia and tungstated tin oxide, by which contact sulfur compounds in a kerosene or gas oil react among themselves (sulfur compounds) and/or with aromatic hydrocarbons. Nor does Toida suggest such a step.

Thus, amended claim 1 is novel and non-obvious over Toida.

Further, claim 1 is non-obvious.

The Examiner acknowledges that Toida does not teach or suggest to desulfurize hydrocarbons using solid superacid catalyst. Accordingly, the Examiner cites Imura which discloses using solid superacid catalyst, and alleges that it is obvious to use solid superacid catalyst of Imura in the invention of Toida.

Imura does disclose contacting light hydrocarbon oil with solid superacid catalyst; however, the process undergoes hydrogenolysis and isomerization leading to desulfurization. Further, the light hydrocarbon oil used in Imura is light naphtha (See page 5, lines 42-58, [0034] and (0035)), and not kerosene or gas oil.

To make the difference between Imura and the present invention more clear, claim 1 now has limited the hydrocarbon oil to "kerosene or gas oil" of prior claim 13.

In this regard, Imura clearly states that the sulfur compounds undergo hydrogenolysis simultaneously with feedstock oil isomerization so that desulfurization can be conducted (page 5, lines 53-54).

On the other hand, the present invention is not desulfurization by hydrogenolysis, but desulfurization wherein the sulfur compounds are made to react among themselves and/or

with aromatic hydrocarbons followed by adsorption desulfurization.

The mechanism of desulfurization is totally different between Imura and the present invention.

It is noted that when sulfur compounds are brought into contact with solid superacid catalyst in the presence of hydrogen, desulfurization by hydrogenolysis (Imura) predominantly occurs.

Importantly, in this Imura process, the reaction among sulfur compounds or the reaction of sulfur compounds with aromatic hydrocarbons (as per the present invention) does not occur. Hence, it is necessary to bring sulfur compounds into contact with the catalyst in the absence of hydrogen for adsorption desulfurization of the present invention.

Thus, claim 1 is non-obvious over Toida alone or in view of Imura.

As to the claim 13 subject matter, the rejection offered Toida, page 2, paragraph [0018] and page 8, paragraph [0094]. These paragraphs do not disclose the claimed invention.

These passages do not teach kerosene or gas oil being brought into contact with a solid superacid catalyst.

This is now more clearly recited in claim 1.

Again, Imura does not cure the defect of Toida.

Rather, Imura teaches desulfurizing a light hydrocarbon oil by contacting the hydrocarbon oil with a superstrong acid

catalyst comprising zirconium oxide (zirconia) and from 1 to 3 wt% sulfuric acid radicals (i.e. SO₄ or sulfate), more specifically hydrocarbon oils are hydrogenated, isomerized and desulfurized.

Please note that the hydrocarbon oils of Imura's are light naphtha (See paragraphs [0034] and [0035]).

It is clearly stated that the sulfur compounds undergo hydrogenolysis simultaneously with feedstock oil isomerization so that desulfurization can be conducted (page 5, lines 53-54).

On the other hand, the present invention does not relate to desulfurization by hydrogenolysis but to desulfurization wherein the sulfur compounds are made to react among themselves and/or with aromatic hydrocarbons followed by adsorption desulfurization. In short, the mechanism of desulfurization is different between the present invention and that of Imura's. This is now more clearly recited in claim 1.

Please note that when sulfur compounds are brought into contact with a solid superacid catalyst in the presence of hydrogen, desulfurization by hydrogenolysis (hydrodesulfurization) occurs, and the reaction among sulfur compounds or the reaction of sulfur compounds with aromatic hydrocarbons does not occur. Hence, it is necessary to bring sulfur compounds into contact with the catalyst in the absence of hydrogen for adsorption desulfurization after reaction among

sulfur compounds themselves or reaction of sulfur compounds with aromatic hydrocarbons.

For these reasons, amended claim 1 is also both novel and non-obvious over Imura. It therefore follows that amended claim 1 is also non-obvious over the combination of Toida and Imura.

Allowance of all the claims is respectfully requested.

The Commissioner is hereby authorized in this, concurrent, and future submissions, to charge any deficiency or credit any overpayment to Deposit Account No. 25-0120 for any additional fees required under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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